Strategic Value Analysis-Geothermal

Geothermal Transmission Workshop
April 11, 2005

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Summary of Strategic Value Analyses (SVA) to Date

- *Identify, quantify and map electricity system needs out through 2017 (capacity, reliability, transmission)*
  - *Selected years (2003, 2005, 2007, 2010 & 2017)*
- *Identify and map out geothermal resources*
  - *Wind, solar, biomass and water (hydro & ocean)*
- *Project environmental, cost and generation performance of renewable technologies through 2017*
  - *Projections developed by PIER Renewable staff; corroborated by work done by EPRI, NREL and Navigant*
- *Conduct combined GIS and economic analyses to obtain "best-fit, least-cost" approach*
- *Develop RD&D targets that help drive forward renewables capable of achieving identified benefits*

SVA-Geothermal Transmission

- ***Identification and Qualification of Resource***
- ***Addition of New Geothermal Resource to the Grid***

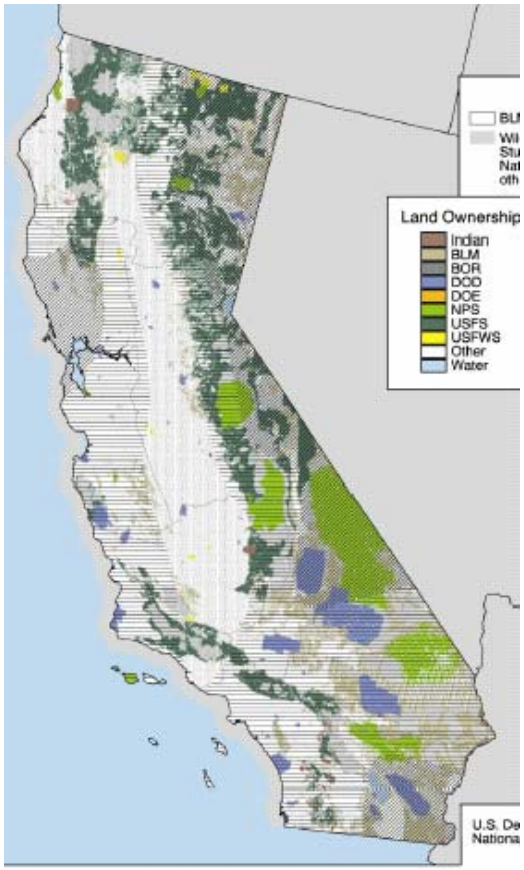
SVA Geothermal Team

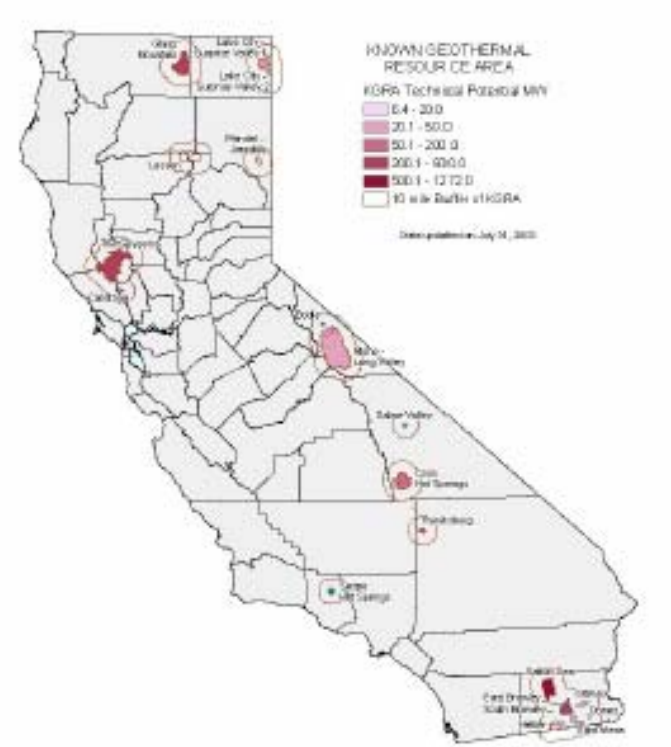
- *CEC Staff*
- *GeothermEx*
- *McNeil Technologies*
- *Davis Power Consultants, Anthony Engineering, and PowerWorld*

Mapping CA's Geothermal Resources

- *Identify the types and amounts of Geothermal that can help resolve "hot spots"*
- *Existing data not readily useful*
  - *Not transferable to GIS*
- *Geothermal resource assessment-identifies and quantifies resource*
- *Data transferred into GIS format*

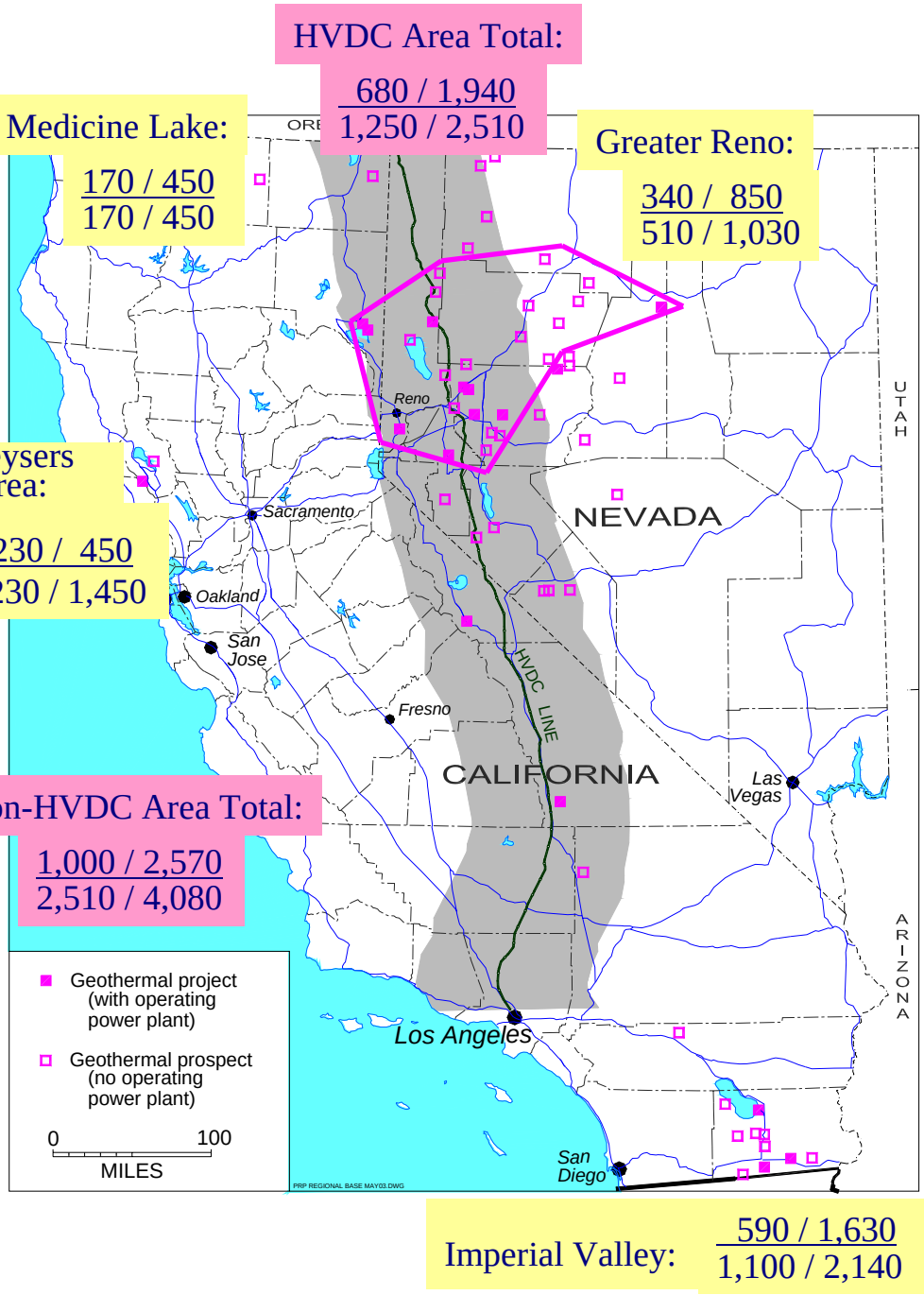
Allows Visual Comparison of Gross vs Technical Geothermal Potentials





Identification and Qualification of Geothermal

- ***Resources Assessment by GeothermEx***



GeothermEx's Resource Assessment of Generating Capacities of Major Geothermal Resource Areas in MW

LEGEND

Minimum Incremental	Most Likely Incremental
Minimum Total	Most Likely Total

Most-Likely Geothermal Resource Capacity

Geothermal Resource Area	County	MLK MW	Existing Gross MW	MLK-Existing MW
Brawley (North)	Imperial	135	0	135
Brawley (East)	Imperial	129	0	129
Brawley (South)	Imperial	62	0	62
Dunes	Imperial	11	0	11
East Mesa	Imperial	148	73.2	74.8
Glamis	Imperial	6.4	0	6.4
Heber	Imperial	142	100	42
Mount Signal	Imperial	19	0	19
Niland	Imperial	76	0	76
Salton Sea (including Westmoreland)	Imperial	1750	350	1400
Superstition Mountain	Imperial	9.5	0	9.5
	Imperial Total:	2487.9	523.2	1964.7
Coso Hot Springs	Inyo	355	300	55
Sulfur Bank Field, Clear Lake Area	Lake	43	0	43
Geysers [Lake & Sonoma Counties]	Sonoma	1400	1000	400
Calistoga	Napa	25	0	25
	The Geysers Total:	1468	1000	468
Honey Lake (Wendel-Amedee)	Lassen	8.3	6.4	1.9
Lake City/ Surprise Valley	Modoc	37	0	37
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	111	40	71
Randsburg	San Bernardino/ Kern	48	0	48
Medicine Lake (Fourmile Hill)	Siskiyou	36	0	36
Medicine Lake (Telephone Flat)	Siskiyou	175	0	175
Sespe Hot Springs	Ventura	5.3	0	5.3
Total:		**4732**	**1870**	**2862**

Strategic Value Analysis-Geothermal Addition to the Grid

Geothermal Transmission Workshop
April 11, 2005

Ron Davis
Principal Consultant
Davis Power Consultants

Addition of Geothermal to the Grid

- ***Model of California's Transmission System***
- ***Economic Analysis with Locational Value Analysis***
  - ***Weighted Transmission Loading Relief Factor (WTLR)***
  - ***Aggregated Megawatt Contingency Overload (AMWCO)***

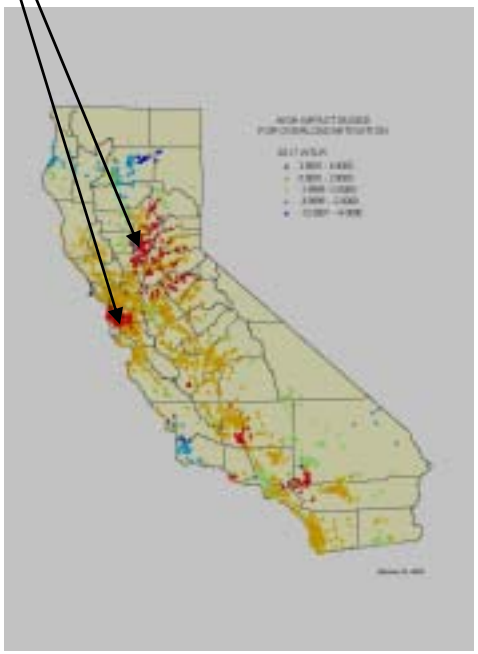
Mapping Renewables to Hot Spots

- ***Electricity Analysis***
  - ***Identifies "hot spots" and magnitude of problem***
    - ***WTLR indicates extent to which solution helps the overall system***
    - ***MW solution quantifies and places the solutions on a geographically precise basis***
      - ***Important in obtaining realistic estimates of solutions and costs***
- ***Mapping Renewables to Hot Spots***
  - ***Assesses if sufficient renewables are located in proximity to "hot spots"***
    - ***Enables transmission upgrades and costs to be identified***

Electricity System: 2010 & 2017

2010 System

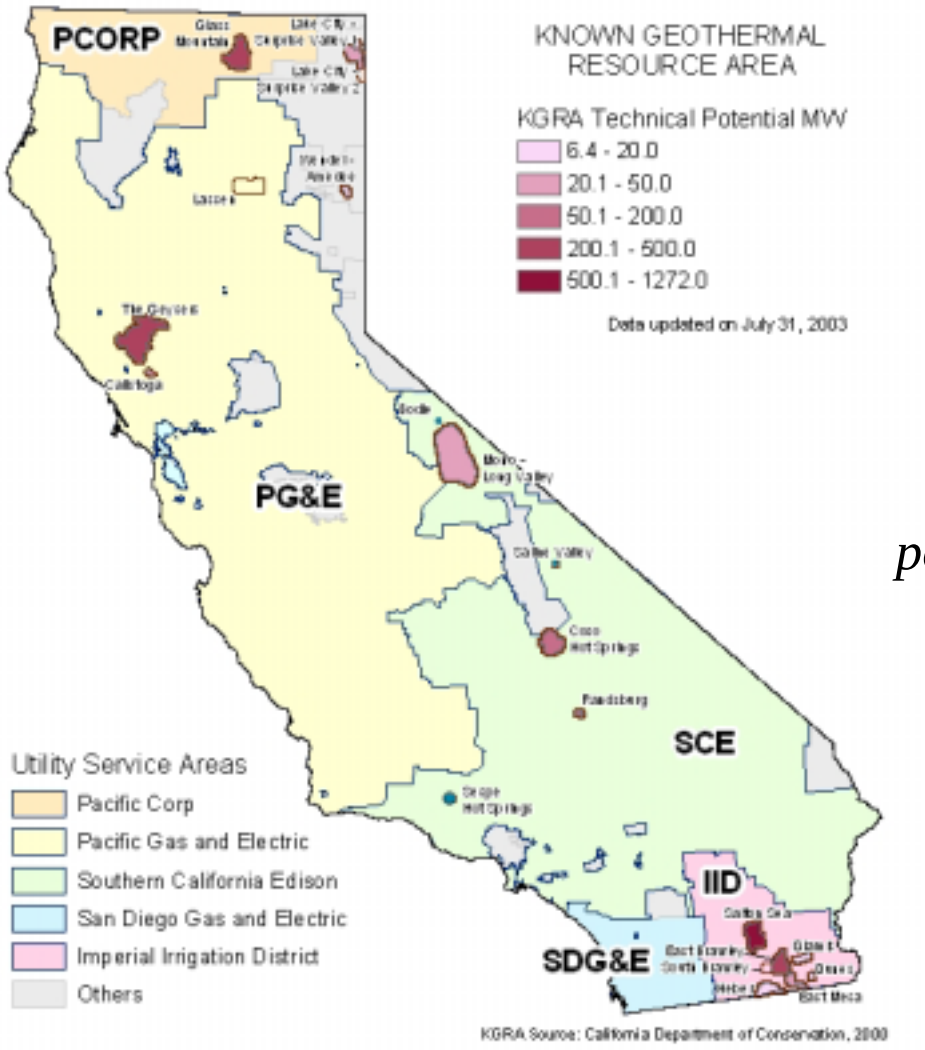
Increasing severity & numbers of reliability problems



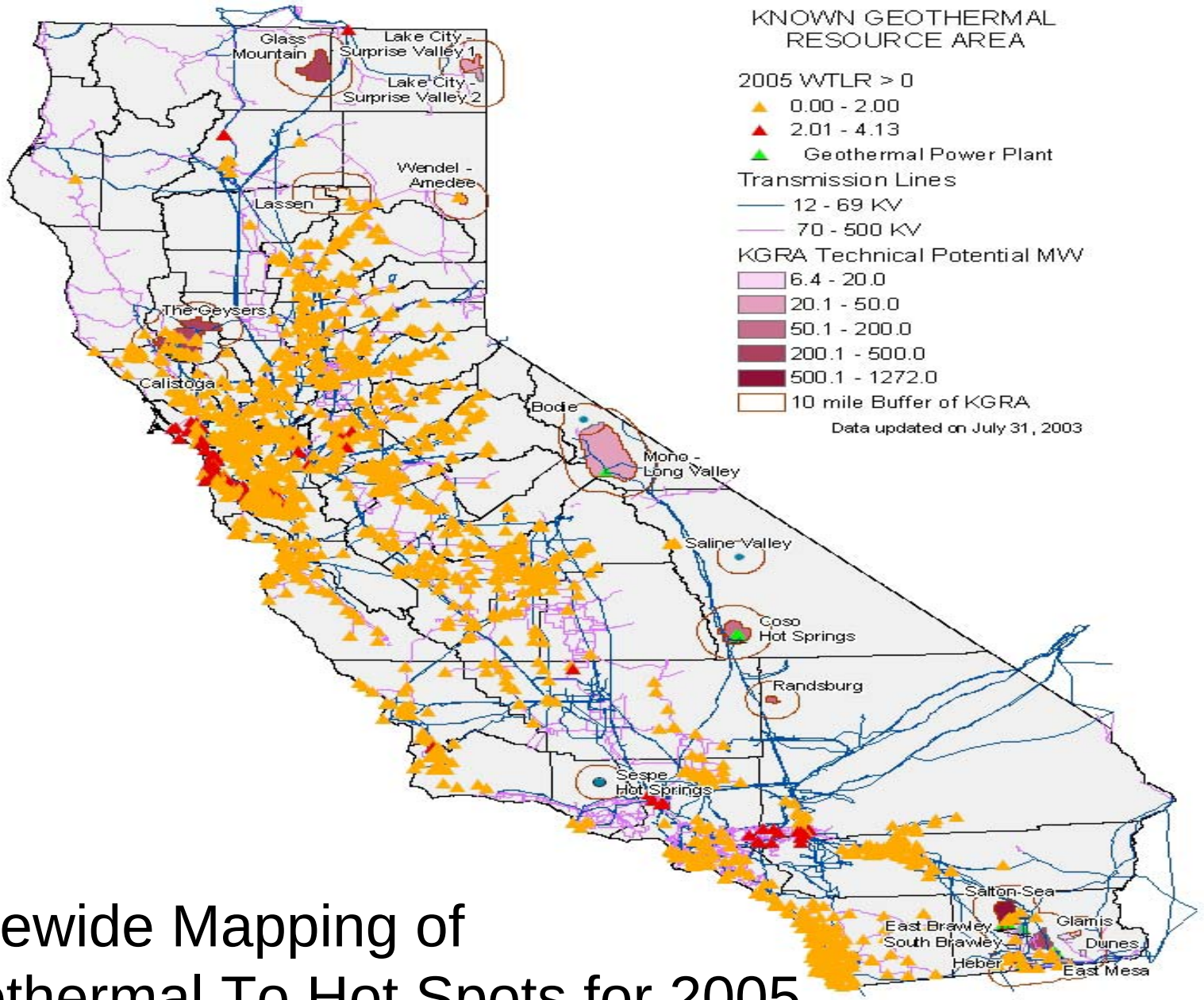
2017 System

- ***Assumptions:***
  - ***Summer peak scenario***
  - ***Demand for 2010 and 2017 extrapolated from 2007 demand levels***
  - ***New generation units in 2010 and 2017 based on CEC input on new generation and transmission***
- ***Results:***
  - ***Continued growth in possible overloads***
    - ***2010: 409 contingencies with 17,256 MW overload potential***
    - ***2017: 674 contingencies with 30,657 MW overload potential***

Geothermal Technical Potential

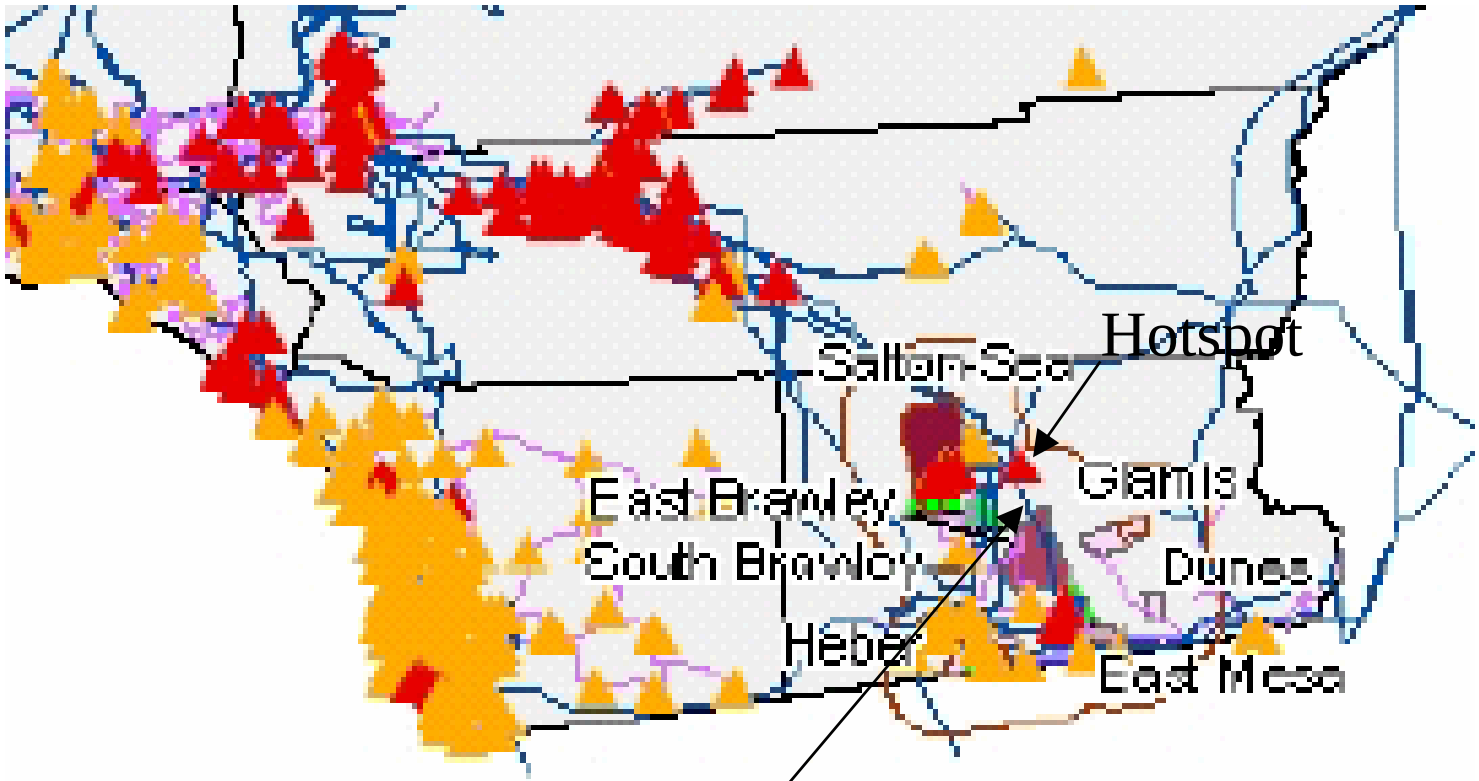


Statewide technical potential over 3800 MW



Statewide Mapping of Geothermal To Hot Spots for 2005

Simplified Example of Mapping Geothermal Resources to Hot Spots



2010 Hotspots

IOU Geothermal Sites

Service Territory	Location	County	Size (MW)
PG&E	Geysers	Lake	100
	Sulfur Bank Field	Lake	43
	Geysers	Sonoma	300
	Calistoga	Napa	25
	Honey Lake	Lassen	2
PacifiCorp	Lake City	Modoc	37
	Medicine Lake	Siskiyou	211
SCE	Coso Hot Springs	Inyo	55
	Long Valley	Mono	71
	Randsburg	San Bernardino	48
	Sespe Hot Springs	Ventura	5
		Total	897

Imperial Valley Sites

Service Territory	Location	County	Size (MW)
IID	Brawley	Imperial	326
	Dunes	Imperial	11
	East Mesa	Imperial	75
	Glamis	Imperial	6
	Heber	Imperial	42
	Salton Sea	Imperial	1400
	Mount Signal	Imperial	19
	Niland	Imperial	76
	Superstition Mint.	Imperial	10
		Total	1,965

Geysers (Lake County and Sulfur Bank Field)

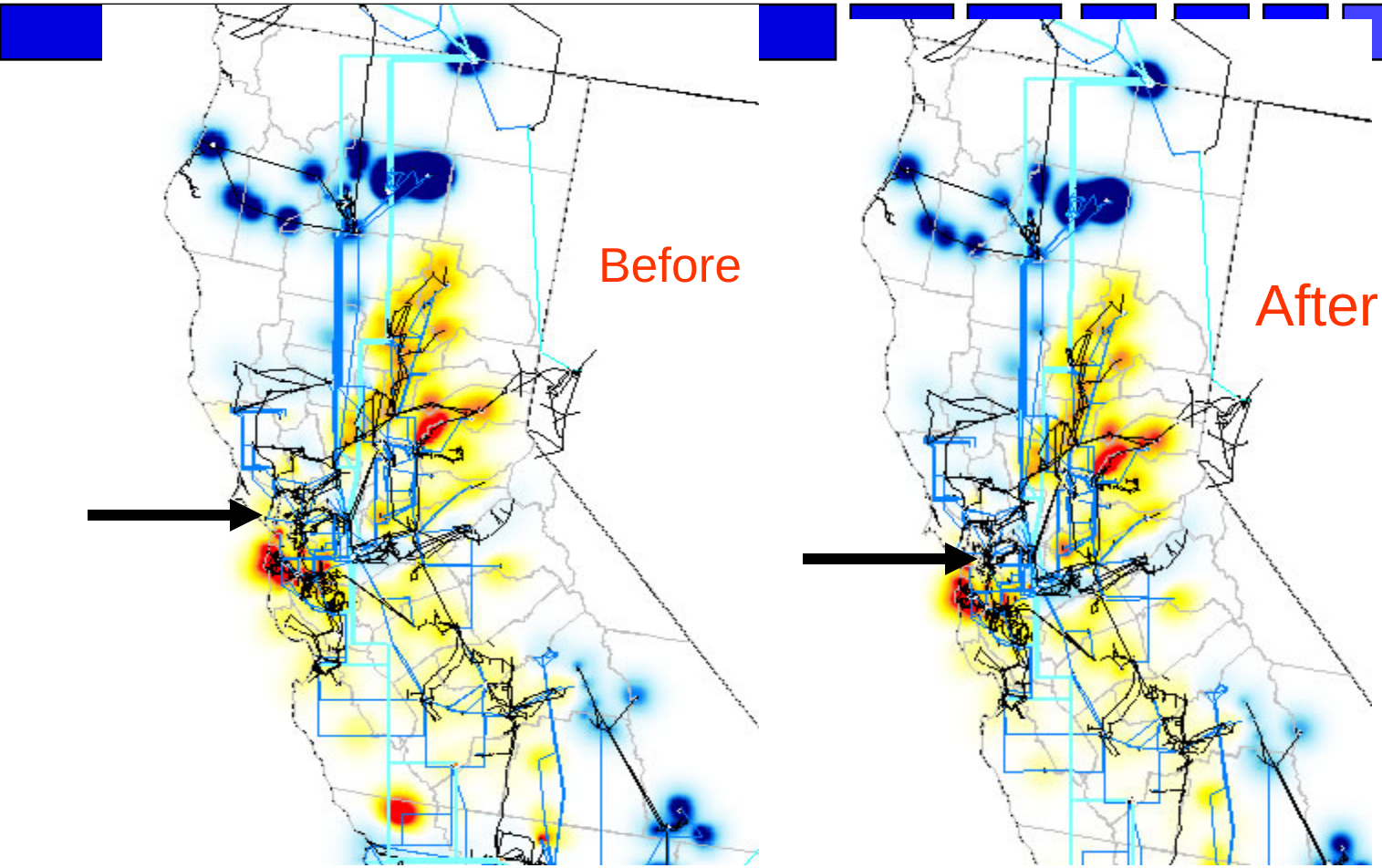
- *143 MW total potential*
- *Located in north end of existing fields*
- *Connected to Eagle Rock substation (bus 31220)*
- *Creates transmission overloads in area*
- *Requires new transformer at Eagle Lake and new 230 kV transmission line between Eagle Lake and Fulton substations*

Projected 2010 Lake County AMWCO Benefit

- *Installed Capacity* *143 MW*
- *AMWCO Impact* *-442 MW*
- *Impact Ratio* *-2.91*

- *Negative AMWCO is a benefit to the system*

2010 Hot Spots – Lake County



Geysers at Sonoma County

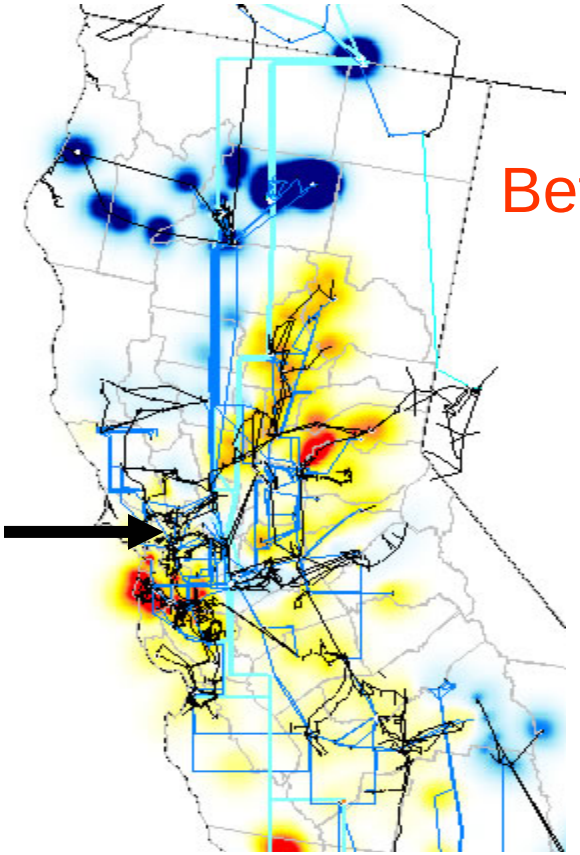
- *Technical potential 300 MW*
- *Located at south end of existing fields*
- *Connected to CR1T3_18 (30391)*
- *Creates transmission overloads*
- *Solution is to install second 230 kV line between CR1T4_23 (30419) and CR1T3_18 and two additional 230 kV lines between CR1T4_23 and Fulton (30430)*

Projected AMWCO

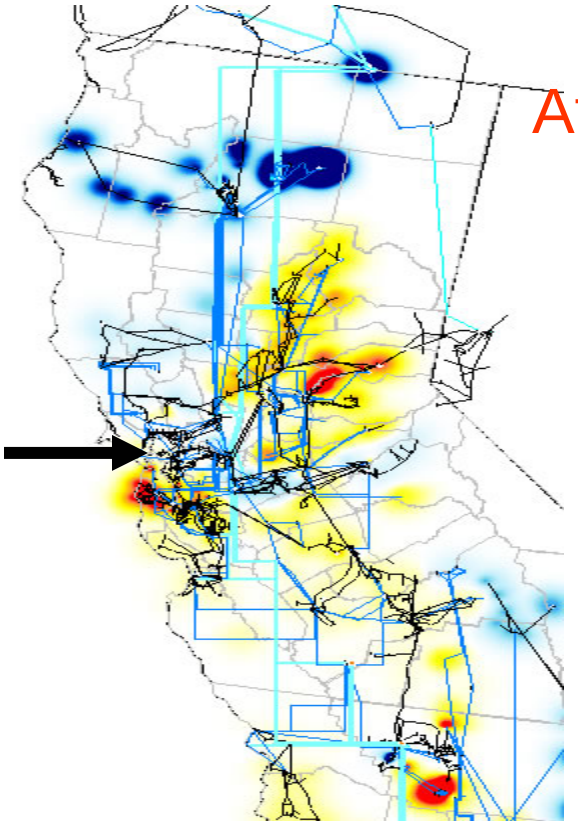
- **Installed Capacity** **300 MW**
- **AMWCO Impact** **-670 MW**
- **Impact Ratio** **-2.23**

- **If both Sonoma and Lake county sites constructed, then combine projects to improve overall benefits**

2010 Hot Spots – Sonoma County



Before



After

Salton Sea in Imperial Valley

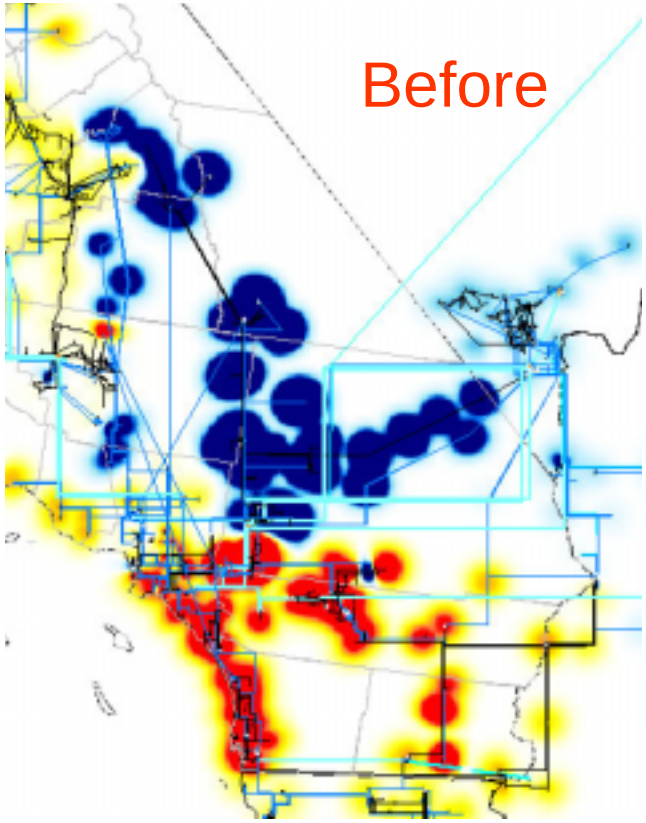
- Technical Potential 1,400 MW
- Located northeast of Salton Sea
- Large size requires 500 kV lines
- 500 kV expansion includes Devers to Mira Loma, Devers to Valley and Serrano, and Devers to new geo substation

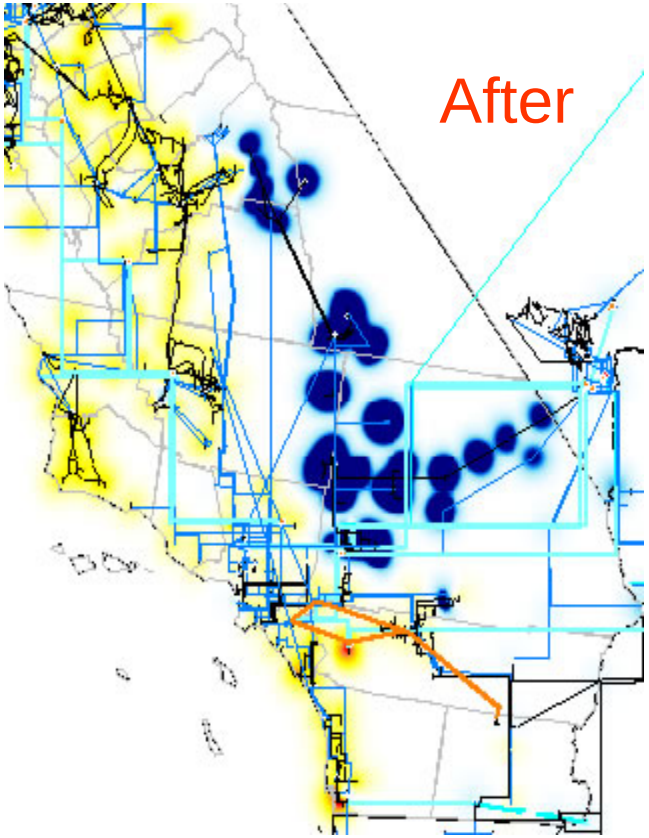
Projected AMWCO

- ***Installed Capacity*** ***1,400 MW***
- ***AMWCO Impact*** ***-715 MW***
- ***Impact Ratio*** ***-0.61***

- ***Even though ratio is less than 1.0, still a good project***
- ***500 kV development supported by SCE renewable concept plan***

2017 Salton Sea Hot Spot After





Salton Sea Transmission Impacts

- ***Because there is new 500 kV transmission development to support the geothermal development, the entire region benefits from more imports, more generation and improved reliability***
- ***If designed properly, other renewable regions (Riverside, Imperial, & San Diego counties) would benefit***

What Isn't Covered Yet

- ***Dispatch***
  - ***Analyses to date have focused on static power flow models***
  - ***No production cost modeling***
- ***Reactive Power***
  - ***To date, only real power analyses***
- ***Fully Integrated Set of Renewables***
  - ***So far, looking at wind vs. geothermal vs. biomass, etc.***
  - ***Fully integrated give better overall scenarios***

Contact Information

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